WEEKLY EVENING MEETING,

30.

Friday, March 5.

W. R. Hamilton, Esq. F.R.S., F.S.A., Vice-President, in the Chair.

Gideon Algernon Mantell, Esq., LL.D., F.R.S.,
President of the West London Medical Society, &c.

On the Structure of the Iguanodon, and on the Fauna and Flora of the Wealden Formation.

The geological phenomena of the South-East of England, comprising the lithological characters and organic remains of the Diluvial, Tertiary, Cretaceous, Wealden, and Oolitic deposits, were described in two Lectures delivered to the Members of the Royal Institution by Dr. Mantell in 1836 and 1849. In those discourses the Fauna and Flora of the *Wealden* were cursorily noticed, and the Iguanodon and other gigantic terrestrial reptiles, whose fossil remains have invested the strata of Tilgate Forest with a high degree of interest, were briefly alluded to. The present Lecture was restricted to a consideration of the Fauna and Flora of the countries whence the deposits constituting the Wealden districts were derived; and the osteological characters of the most remarkable fossil Saurians peculiar to this geological epoch, were especially illustrated.

After a concise exposition of the characters of the various formations which have succeeded, and now overlie, or in other words, are of more recent origin than the Wealden, — namely, the *Drift* or Diluvium, containing bones of large mammalia, as the Mammoth, Mastodon, Rhinoceros, Horse, Deer, &c; — the *Eocene*, or ancient tertiary strata of the London basin, abounding in marine exuviæ of special and for the most part extinct types; — and the *Cretaceous* or Chalk-Formation, comprising the White-Chalk of the North and South Downs, and the Chalk-marl, Galt, and Greensand, of Surrey, Kent, and Sussex, the whole characterized by innumerable marine shells, zoophytes, fishes, reptiles, &c. of extinct species and genera; — Dr. Mantell proceeded to illustrate the structure of the Iguanodon as exemplified by the isolated parts of the skeleton hitherto discovered, and of which numerous examples were exhibited on the tables of the Institution.

The perfect germ, and the unused tooth, of the Iguanodon, are characterised by the prismatic form of the crown, which is traversed on the thick enamelled face by three or four longitudinal ridges, and has the lateral margins denticulated, and the summit finely crenated; in this state the teeth resemble those of the living *Iguana* of the West Indies, — a resemblance which suggested the generic name of *Iguanodon*. But the fossil teeth are of enormous size in comparison with their recent prototypes; for the teeth of the Iguana are as

small as those of the mouse, while those of the Iguanodon are often one inch wide, and three inches in length. Specimens exhibiting the above characters are however, rare; the summit of the crown is usually more or less worn away by use, and the fang removed by absorption from the pressure induced by the upward growth of the successional teeth. In the first example discovered by Dr. Mantell (in 1820), the crown was ground down so as to present on its inner face a smooth oblique surface with a cutting edge on the summit, and the marginal crenations were worn away; in this state the fossil so strikingly resembled an upper tooth of a Rhinoceros, that Baron Cuvier pronounced it to belong to a species of that genus. Numerous teeth in different stages of growth and detrition were at length obtained, and the reptilian character of the animal to which they belonged was satisfactorily determined. Three years since, the first specimen of the lower jaw was discovered by Captain Lambart Brickenden, in the same quarry in Tilgate Forest from which the earliest known tooth was obtained; and subsequently a portion of the upper jaw with teeth, has been procured from the Hastings' strata.

Referring to his various Memoirs on the Iguanodon in the Philosophical Transactions, and to his recent work on the Organic Remains in the British Museum,* for details, the Lecturer stated, that while the compound structure of the lower jaw, and the mode of dentition, established the reptilian character of the original animal, the maxillary organs presented a nearer approach to those of certain mammalia, than is observable in any other reptiles. The teeth in the upper and lower jaw were arranged in a sub-alternate order as in ruminants; the face of the crown, or that having the thickest coat of enamel, is placed mesially or on the inner side of the lower teeth, and on the external surface of the upper. The anterior part of the lower jaw is edentulous, and its symphysial extremity forms a scoop-like process, which resembles the corresponding part of the inferior jaw of the Edentate mammalia, as for example the *Mylodons:* and the great number and size of the vascular foramina of the jaw indicate a greater development of the lips, and integuments, than occurs in any existing animals of the class Reptilia; the sharp ridge bordering the deep groove of the symphysis, in which there are likewise several foramina for the exit of nerves and blood-vessels, evidently gave attachment to the muscles and integuments of the lip: while two deep pits for the insertion of the protractor muscles of the tongue, manifest the mobility and power of that organ. There are therefore strong reasons for supposing that the lips in the Iguanodon were flexible, and in conjunction with the long fleshy prehensile tongue, were the chief instruments for seizing and cropping the leaves, branches, and fruit, which from the construction of the teeth we may infer constituted the food of the original. The mechanism of the maxillary organs as eluci-

* "Petrifactions and their Teachings, or a Hand-book to the Gallery of Organic Remains of the British Museum," one vol. 1851, published by H. G. Bohn.

dated by recent discoveries is thus in perfect harmony with the remarkable characters which rendered the first known teeth so enigmatical: and in the Wealden herbivorous reptile we have a solution of the problem, how the integrity of the type of organization peculiar to the class of cold-blooded vertebrata was maintained, and yet adapted, by simple modifications, to fulfil the conditions required by the economy of a gigantic terrestrial reptile, destined to obtain support from vegetable substances: in like manner as the extinct colossal herbivorous Edentata, which flourished in South America, countless ages after the country of the Iguanodon and its inhabitants had been swept from the face of the earth.

The structure of the cervical, dorsal, and caudal vertebræ, of the ribs, the pectoral and pelvic arches, the sacrum formed of six anchylosed vertebræ, the bones of the extremities, and certain dermal appendages, were successively described, and illustrated by drawings and specimens. From the facts adduced Dr. Mantell infers that this stupendous reptile equalled in bulk the largest herbivorous mammalia, and was as massive in its proportions; for living exclusively on vegetables, the abdominal region must have been greatly developed. Its limbs were of proportionate size and strength, to support and move so enormous a carcass; its length, as proved by recent discoveries, was of crocodilian proportions, for there is no doubt that the tail was very long; and the largest Iguanodon may have attained a length of from fifty to sixty feet.

The *Hylæosaurus*, *Megalosaurus*, and several other genera of reptiles were severally noticed, and reference made to the specimens in the British Museum. The *Pelorosaurus* was next described somewhat in detail, and the characters of the stupendous humerus, or arm-bone, ($4\frac{1}{2}$ feet long), scapula, clavicle, vertebræ, sacrum, and pelvis, were pointed out, with the view of illustrating a most interesting discovery made but a few days previously by S. H. Beckles, Esq. of St. Leonard's.

With much labour and skill, Mr. Beckles had succeeded in extracting from a block of Wealden sandstone lying on the Sussex coast, and which was only visible at low-water, the perfect *radius* and *ulna* (bones of the fore-arm), and *humerus* (arm-bone), of a gigantic reptile, which Dr. Mantell pronounced to be a *new species of Pelorosaurus*, and proposed to name *Pelorosaurus Becklesii*. The generic identity and specific difference between this humerus and that of the *Pel. Conybeari*, which was placed beside it, were pointed out, and the remarkable modification of structure presented by the *ulna* was explained. The arm-bone of the *P. Conybeari* is 54 inches long, the corresponding bone of a Gavial or gangetic Crocodile 18 feet long, in Dr. Grant's Museum, is but $11\frac{1}{2}$ inches; the humerus discovered by Mr. Beckles is $22\frac{1}{2}$ inches in length, and the bones of the fore-arm are 16 inches long. A portion of the scaly cuirass which covered the limbs and is composed of hexagonal plates, was exhibited.

The Lecturer then took a rapid view of the other reptiles that were contemporary with the Iguanodon, enumerating the *Pterodactyles* or

flying lizards, and several genera of Crocodilians and Chelonians. Examples of marine and fresh-water turtles are not uncommon in the Wealden deposits; and the strata near Swanage have furnished many beautiful specimens to the researches of Mr. Bowerbank.

Of *Fishes* there are nearly forty known species in the Wealden, which are chiefly referable to the *Ganoid* and *Placoid* orders. The fishes most abundant in the rivers of the Iguanodon country were two or three species of *Lepidotus*, — ganoids closely allied to the *Bony* or *Gar-Pike* of America; their teeth and scales are everywhere to be met with in the Tilgate strata.

The *Invertebrate Fauna* comprised many genera of *Insects*, a few *Crustaceans*, and numerous fresh-water *Mollusca*. The *Insects* (for a knowledge of which we are mainly indebted to the scientific acumen of the Rev. P. Brodie) amount to several hundred specimens, comprising between thirty and forty families or genera, and are referable for the most part to the orders *Colcoptera*, *Orthoptera*, *Neuroptera*, *Hemiptera*, and *Diptera*. Among them are several kinds of Beetles, Dragon-flies, Crickets, May-flies, and other familiar forms which are closely allied to species that inhabit temperate climates.

Mollusca. The most numerous shells belong to the genera *Cyclas* and *Paludina*; of the latter, which is a genus of fresh-water snails, there are a few species that abound in the Wealden Clays and Purbeck beds, and form extensive strata of shelly limestone, the compact masses of which are susceptible of a good polish and are well known by the names of Sussex, Petworth, and Purbeck Marble; the latter was in great request in the medieval ages, and is the material of which numerous tombs and monuments, and cluster columns in our ancient Cathedrals are constructed. Two common inhabitants of our pools and streams, the Planorbis and Limneus, also occur. Several species of *Unio*, some of which rival in magnitude the pearl-mussels of the Ohio and Mississippi, likewise abound in the Wealden deposits. Fresh-water Entomostraceans, *Cyprides*, of several species, swarm in many of the clays and iron-stone beds of Sussex and the Isle of Wight.

The Flora of the country of the Iguanodon appears to have been as rich and diversified as the Fauna. Forests of *Coniferæ*, referable or closely allied to *Abies*, *Pinus*, *Araucaria*, *Cupressus*, and *Juniperus*, clothed its hills and plains: with these were associated arborescent and herbaceous Ferns, comprising upwards of thirty species; together with many *Cycadeaceæ*, and trees allied to the *Dracæna*, *Yucca*, *&c*. Equistaceous and Lycopodiaceous plants also abounded; and even the common inhabitants of our streams, the *Charæ*, flourished in the rivulets of that marvellous region.

As examples of the vegetation of the Wealden period, Dr. Mantell described the petrified forest of coniferæ and cycadeæ in the Isle of Portland: the accumulation of fossil firs and pines exposed on the southern shore of the Isle of Wight; and the coal-field of Hanover, which entirely consists of the carbonized foliage,

trunks, and branches, of coniferous trees, drifted from the country of the Iguanodon.

The facts thus rapidly noticed prove that during the deposition of the Wealden, Oolitic, and Cretaceous strata, there existed an extensive Island or Continent, diversified by hills and valleys, and traversed by streams and rivers teeming with fishes, crustaceans, and mollusca, closely allied to types which at present inhabit the fresh-water of temperate regions; and that with these were associated fluviatile turtles, and crocodilian reptiles, whose living analogues are restricted to tropical climes. Colossal herbivorous and carnivorous saurians, differing essentially in structure from all known existing forms, were the principal inhabitants of the dry land; and these, together with flying lizards, and possibly a few birds, and very small mammalia, constituted the vertebrate fauna of the country, or countries, which supplied the materials of the Wealden strata, and of the fluvio-marine deposits which are intercalated with the purely oceanic beds of the Oolite and Chalk.

Thus it appears, according to the present state of our knowledge, that the classes Mammalia and Aves, which constitute the essential features of the terrestrial zoology of most countries, were represented through a period of incalculable duration solely by two genera of very diminutive mammals, and a few birds; while the air, the land, and the waters, swarmed with peculiar reptilian forms, fitted for aerial, terrestrial, and aquatic existence.

Admitting to the fullest extent the effect of causes that may be supposed to have occasioned the absence of mammalian remains in the secondary deposits, yet the immense preponderance of the reptile tribes is unquestionable. Some authors have attempted to account for this anomaly by assuming that antecedently to the Eocene period, our planet was not adapted for the existence of mammalia, in consequence of its atmosphere being too impure to support higher types of animal organization than the cold-blooded vertebrata. But the certainty that some forms of marsupial and placental mammalia inhabited the countries of the Megalosaurus and Pterodactyle, — that birds in all probability existed with the Iguanodon, — and the fact that insects and mollusca, and trees and plants, which now inhabit regions abounding in birds, and mammalia, flourished during the "Age of Reptiles,"— demonstrate that the physical conditions of the earth, and the constitution of the atmosphere, and of the waters, differed in no essential respect from those which now prevail, and that the laws which govern the organic and inorganic kingdoms of nature have undergone no change.

That the class Reptilia was developed during the periods embraced in this discourse to an extent far beyond what has since taken place appears to be indisputable; nor can any satisfactory solution of the problem be offered from the data hitherto obtained. Future discoveries may however show that coeval with the country of the Iguanodon there were regions tenanted by birds and mammalia; and that the almost exclusively reptilian fauna of the lands whose zoological and botanical characters have formed the

subject of this Lecture, was but an exaggerated condition of that state of the animal kingdom which is exhibited by the present fauna of the Galapagos Islands.*

In conclusion Dr. Mantell alluded to the recent discovery of reptilian remains (the *Telerpeton Elginense*, and the presumed Chelonian foot-tracks') in the Old Red Sandstone of Morayshire,† in proof of the necessity of bearing in mind the salutary caution of Sir Charles Lyell, "that as our acquaintance with the living creation of past ages must depend in a great degree on what we term chance, we ought never to assume that the first creation of any type of animals or plants took place at the precise point where our retrospective knowledge happens to stop."

In the Library were exhibited: —

Section of Bones of the Iguanodon, shewn by the Microscope. [Exhibited by A. J. Woodhouse, Esq. M.R.I.]

Drawing of the Notornis Mantelli, by Mr. Gould, and Drawings of the Iguanodon by J. Martin, Esq., R.A., &c. [Exhibited by Dr. Mantell.]

Fossils from the Coal-pits, Lesmahago, Scotland, presented by Captain Inglefield.

Portrait of Mrs. S. C. Hall by D. Maclise, and Frame carved by Mr. W. G. Rogers.

Specimens of Sussex and Purbeck Marbles. [Exhibited by Mr. C. H. Smith.]

Otter, Fox, and Cocks of the Rock, from Brazil and California, and Apteryx Australis, — mounted by Messrs. Leadbeaters.

Tazza with Engraving, "Nature," after Lawrence — Vases inlaid with specimens of Marbles, &c. and Bronzes. [Exhibited by Mr. Tennant.]

Manganese Oxyd and other Minerals. [Exhibited by Mr. Highley, jun.]

Specimens of Chasing in Silver, by Mr. Higgins.

Models of the Steam-Engines of Savery, Newcomen, and of Watt. [Exhibited by Mr. Addams.]

The Circulation of the Sap in the Nitella flexilis, a Water-plant, was shown microscopically by Mr. C. Varley.

In the Ante-room was exhibited: —

A Sectional Model of Condensing Engine by Messrs. Watkins and Hill.

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* See "Wonders of Geology," Sixth Edition, p. 893.

† Lyell's "Manual of Geology," Fourth Edition, p. x.